UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

August 7, 2014

Certified Mail
Return Receipt Requested

Advanced Micro Devices, Inc.
Attn: Mr. Brett Stringer
One AMD Place
Sunnyvale, CA 94088-3453

brett.stringer@amd.com
Certified Mail Label # 7010 2780 0000 2815 8171

Northrop Grumman Systems Corporation
Attn: Ms. Amy Sullivan
2989 Fairview Park Drive
Falls Church, VA 22142

amy.sullivan@ngc.com
Certified Mail Label # 7010 2780 0000 2815 8157

Philips Semiconductors, Inc.
c/o Project Realty LLC
Attn: Ms. Shau-Luen K. Barker
15313 West 95th Street
Lenexa, Kansas 66219

shauluen@aol.com
shauluen.barker@philips.com
Certified Mail Label # 7010 1060 0002 0242 5569

SUBJECT: Notice of Lead Agency Transfer – California Regional Board to US EPA

Triple Site: AMD 901/902 Thompson Place Superfund Site, Philips (formerly Signetics) Site, and TRW Microwave Superfund Site and Offsite Operable Unit, Sunnyvale, California

Dear Mr. Stringer, Ms. Sullivan, and Ms. Barker:

The California Regional Water Quality Control Board, San Francisco Bay (Regional Board) has been the lead agency for overseeing cleanup activities at the Advanced Micro Devices 901/902 Thompson Place Superfund Site (AMD 901/902 Site), Philips (formerly Signetics) Site (Philips Site), TRW Microwave Superfund Site (TRW Site), and associated Offsite Operable Unit (OOU, collectively known as the Triple Site, henceforth "Site"). This was pursuant to the South Bay Multi-Site Cooperative Agreement (October, 1985) and the South Bay Ground Water Contamination Enforcement Agreement (May, 1989), entered into by the Regional Board and US EPA (collectively, the Agencies). US EPA has been involved at the Site and others in the South Bay for several years supervising vapor intrusion investigations.

Lead Agency Transfer – California Regional Board to US EPA

The Regional Board and US EPA have determined that it is appropriate to transfer the Lead Agency role for the Site to the US EPA (see attached letters), because US EPA is in a better

position to oversee the vapor intrusion evaluations necessary at the Site and to amend the Record of Decision (ROD) for the Site signed in 1991 which did not address the subsurface-to-indoor air vapor intrusion pathway at the Site.

Sensitive Population at Risk

Additionally, the Agencies' rationale for transferring Lead Agency role includes a recognition of the sensitive population at risk in the OOU – the residential neighborhood north of Duane Avenue that is comprised of schools (infant daycare, preschool, two elementary schools and one high school) and over 100 homes – the largest residential at-risk area of all the South Bay National Priorities List (NPL) sites regulated by the Regional Board (see attached map).

Indoor Air Level Exceedances

US EPA notes that indoor air sampling results collected from certain buildings in the neighborhood, including data from as recent as 2012, exceed current US EPA residential Regional Screening Levels (RSLs) for trichloroethene (TCE). The levels measured include concentrations that are prompting comprehensive mitigation work by Responsible Parties (RPs) at other South Bay NPL sites.

Work Plan Noncompliant Despite Continued Findings of Vapor Intrusion Impacts

Finally, Lead Agency transfer is appropriate that the RPs for the Site, including Advanced Micro Devices, Inc. (AMD), Northrop Grumman Systems Corporation (Northrop Grumman), and Philips Semiconductors, Inc. (Philips), have not submitted to the Agencies a Work Plan that meets US EPA's minimum requirements for investigating vapor intrusion and which have previously been communicated to the RPs for the Triple Site (see attached). Specific sampling recommendations made by US EPA following a September 30, 2013 survey of certain OOU buildings were not addressed in the Additional Vapor Intrusion Work Plan submitted by Locus Technologies on Philips Semiconductors' behalf on May 1, 2014, nor were other key guidelines subsequently provided by US EPA incorporated.

US EPA notes, in particular, the RSL exceedances at certain OOU buildings. Also noted are the concurrent indoor air investigations at other South Bay NPL sites with similar depth to groundwater and TCE shallow-zone concentrations, including nearby sites in Sunnyvale, which continue to show TCE screening level exceedances at both residential and commercial buildings overlying concentrations ranging from 5 micrograms per liter (µg/L) to over 100 µg/L TCE in shallow-zone groundwater which are requiring mitigation.

Liability Under CERCLA

While the AMD 901/902 Site and TRW Site are listed on the NPL, the Philips Site is not currently on the NPL. US EPA proposed its listing in 1989 but decided against listing at that time because the Philips Site was being regulated as a Resource Conservation and Recovery Act (RCRA) site. However, the 1991 ROD identified the three sites – the AMD 901/902 Site, the TRW Site, and the Philips Site – as all contributing to the commingled TCE plume in the OOU.

The Philips Site is now a closed RCRA facility and, together with the AMD 901/902 Site and TRW Site, is responsible for the volatile organic compound (VOC) groundwater contamination at the Site, which includes TCE in shallow-zone groundwater that has migrated into the OOU and which poses a threat to overlying buildings via the vapor intrusion pathway.

The Philips Site is a "facility" as that term is defined in Section 101(9) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the past disposal and migration of hazardous substances at the Philips Site constitute a "release" and continuing threat of "release" as defined in Section 101(22) of CERCLA. Thus the Philips Site is responsible under CERCLA law for investigation and remediation work related to the Site, including the OOU, and falls under US EPA Superfund Program authority.

Notice of Deficiency and Requirement to Respond

US EPA is preparing a Notice of Deficiency and Requirement to Prepare and Implement a Vapor Intrusion Work Plan (Notice of Deficiency).

US EPA invites you to a meeting within the next two (2) weeks to discuss the possibility of an Administrative Order on Consent (AOC) for development and implementation of a Vapor Intrusion Work Plan. Regardless whether a meeting takes place within this timeframe, please advise us within two (2) weeks if you are interested in an AOC with US EPA. In the event that you decline to comply with the Notice of Deficiency and are not interested in an AOC, US EPA may issue an Administrative Order pursuant to CERCLA Sections 106(a) and 107 to order the RPs for the Site to develop and implement a Vapor Intrusion Plan and other remedial action activities to address the threat to public health or welfare at or from the Site due to the vapor intrusion pathway.

If you have any questions regarding the technical requirements in this letter, please contact Melanie Morash, Remedial Project Manager, directly at (415) 972-3050 or by e-mail to morash.melanie@epa.gov. Any legal questions should be directed to Thelma Estrada, US EPA attorney for this matter, at (415) 972-3866 or by e-mail to estrada.thelma@epa.gov.

Sincerely,

John Lyons
Acting Assistant Director,
Superfund Division

Attachments:

Triple Site Mailing List
Triple Site Map
EPA Case Transfer Letter to Regional Board
Regional Board Case Transfer Letter to EPA
July 11, 2014 EPA Letter to Regional Board
July 9, 2014 EPA Region 9 Memorandum
June 30, 2014 EPA Region 9 Memorandum
Dec. 19, 2013 EPA Region 9 Vapor Intrusion Comments Memorandum – Triple Site
Dec. 3, 2013 EPA Region 9 South Bay Vapor Intrusion Guidelines Letter

TRIPLE SITE MAILING LIST

San Francisco Bay Regional Water Quality Control Board
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Max Shahbazian — max.shahbazian@waterboards.ca.gov

State Water Resources Control Board
Office of Chief Counsel
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EPA Region 9
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Lani Lee — lani.lee@deh.sccgov.org

County of Santa Clara Public Health Department
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John Stufflebean — jstufflebean@sunnyvale.ca.gov
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shauluen.barker@philips.com

Northrup Grumman Systems Corporation
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Barg Coffin Lewis & Trapp, LLP
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Mike Calhoun — mcalhoun@haleyaldrich.com

Center for Public Environmental Oversight
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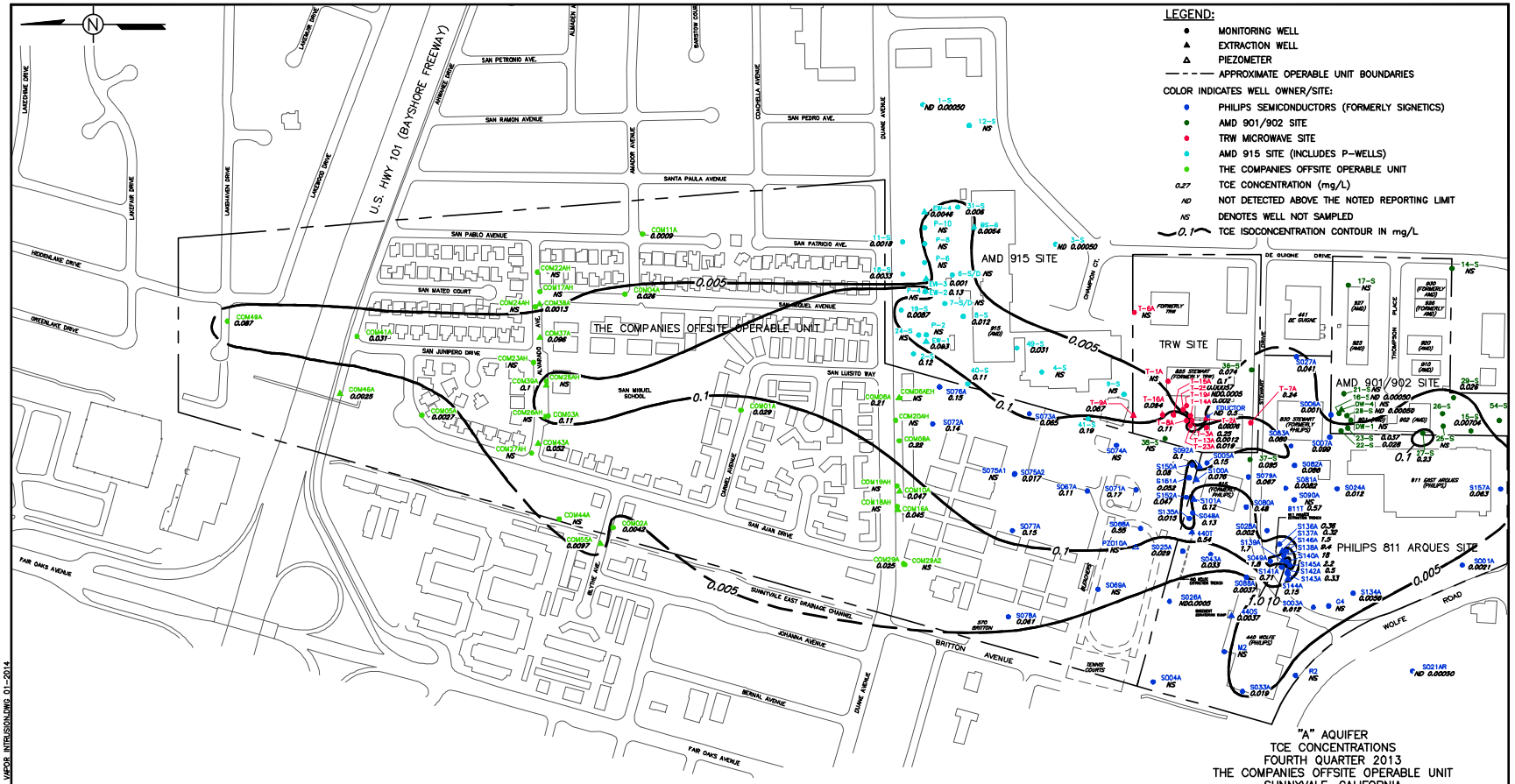

"A" AQUIFER
TCE CONCENTRATIONS
FOURTH QUARTER 2013
THE COMPANIES OFFSITE OPERABLE UNIT
SUNNYVALE, CALIFORNIA

PREPARED FOR

PHILIPS ELECTRONICS

REFERENCES:

1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1	14 JAN 14	ISSUED FOR REPORT	TH	JWH	JWH

Locus TECHNOLOGIES

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DRAWING NO. 27-006-B422

FIGURE 3

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

August 7, 2014

Bruce H. Wolfe
Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay St., Suite 1400
Oakland, California 94612

Re: Proposed Case Transfer - AMD 901/902 Thompson Place Superfund Site, Philips (formerly Signetics) Site and TRW Microwave Superfund Site (collectively, Triple Site) – Sunnyvale, California

Dear Mr. Wolfe:

Pursuant to our recent discussions, the Regional Water Quality Control Board ("Regional Board") and US EPA have agreed to transfer lead oversight for the Triple Site from the Regional Board to US EPA, Region 9.

The Regional Board has been the lead agency for overseeing cleanup activities at South San Francisco Bay Superfund Sites (South Bay Sites), including the Triple Site, pursuant to the South Bay Multi-Site Cooperative Agreement (October, 1985) and the South Bay Ground Water Contamination Enforcement Agreement (May, 1989).

At this juncture, staff of the Regional Board and US EPA conclude that the Triple Site is ripe for transfer back to US EPA. The rationale for this determination is as follows:

- The recent issuance of US EPA Region 9 trichloroethene (TCE) and vapor intrusion guidelines will prompt a significant expansion of the vapor intrusion study area and it will be more efficient for one agency to oversee the expanded investigation;

- Transfer of lead agency oversight is appropriate given the sensitive population at risk at the Triple Site, which includes the largest residential neighborhood of all of the National Priorities List (NPL) sites under Regional Board oversight (including infant/day care, pre-school, elementary and high school, and a residential area of over 100 homes);

- Resources and level of expertise place US EPA in a better position to oversee the vapor intrusion evaluations necessary at the Triple Site; these evaluations will be used to amend the Record of Decision (ROD) for the Triple Site, signed in 1991, to address the subsurface-to-indoor air vapor intrusion pathway; and,

- The pace at which this particular investigation is occurring is not commensurate with the need for more absolute certainty that vapor intrusion is being investigated and addressed.

Staff at our two agencies have already discussed transition tasks, including issuance of a Notice of Deficiency (NOD) and Requirement to Prepare and Implement a Vapor Intrusion Work Plan for Philips Site Source Buildings and Offsite Operable Unit Letter by US EPA and rescission of the Regional Board's Site Cleanup Requirements Order for the Triple Site.
US EPA is prepared to issue a letter to the Responsible Parties (RPs) at the Triple Site announcing the transfer. This letter will also be sent to the Triple Site mailing list for community notification.

Please call me if you would like to discuss this further. We appreciate all of the continuing work by you and your staff on the South Bay Sites and we value the partnership with the Regional Board on these important matters.

Sincerely,

Enrique Manzanilla
Director, Superfund Division

California Water Boards

Edmund G. Brown Jr., Governor

Matthew Rodriquez, Secretary for Environmental Protection

San Francisco Bay Regional Water Quality Control Board

August 7, 2014
File Nos: 43S0004, 43S0114, 43S1005 (MS)

U.S. EPA, Region IX
Attn: Enrique Manzanilla, Superfund Division Director (manzanilla.enrique@epa.gov)
75 Hawthorne Street
San Francisco, California 94105

Subject: Recommended Case Transfer – Former TRW Microwave site at 825 Stewart Drive, former AMD site at 901/902 Thompson Place, and former Philips Semiconductors site at 811 East Arques Avenue, Sunnyvale, Santa Clara County

Dear Mr. Manzanilla:

The Regional Water Board is currently the lead agency for overseeing cleanup activities at the subject sites. We refer to these three sites collectively as the "Triple Site" because their groundwater plumes are commingled. Our oversight has extended over a period of many years and has addressed all phases of investigation and cleanup, including implementation of an approved final cleanup plan. The Regional Water Board oversees these and 11 other federal Superfund sites with the expressed consent of the U.S. Environmental Protection Agency (U.S. EPA), the federal agency responsible for implementing the Superfund law (CERCLA).

At this juncture, we recommend that the Triple Site be transferred from the Regional Water Board to U.S. EPA Region IX. This transfer would include each of the three individual subject sites and the combined offsite area. U.S. EPA Region IX would then be the lead agency for all aspects of the Triple Site. Our rationale for this recommendation is as follows:

- Recent U.S. EPA Region IX vapor intrusion guidelines have resulted in a significant expansion of the vapor intrusion study area for the Triple Site
- There is a large residential area and three schools in the expanded vapor intrusion study area, and vapor intrusion evaluation will therefore require significant public outreach
- U.S. EPA Region IX has adequate staffing to manage the Triple Site and has in-house public participation staff that would be able to provide necessary public outreach
- Philips has not yet submitted an acceptable vapor intrusion work plan for the expanded study area, and delays in further evaluation of vapor intrusion in this area may endanger human health

If you agree with this recommendation, please send us a confirmation letter. We understand that the actual transfer would take place when the responsible parties and other interested parties have been notified of the transfer.

If you have any questions, please contact Stephen Hill of my staff at (510) 622-2361, or by e-mail at shill@waterboards.ca.gov.

Sincerely,

Digitally signed by Stephen Hill
Date: 2014.08.07 10:52:34
-07'00'

Bruce H. Wolfe
Executive Officer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

July 11, 2014

Stephen Hill, Chief
Toxics Cleanup Division
California Regional Water Quality Control Board,
San Francisco Bay Region
1515 Clay Street #1400
Oakland, Ca 94612

Dear Mr. Hill,

On July 10, the US EPA Region 9 Superfund Division Director, Enrique Manzanilla, issued a memorandum to the Superfund Division transmitting a memorandum from the Division's toxicologists regarding action levels, investigation approaches and response measures to address inhalation exposures to TCE in indoor air and the subsurface vapor intrusion pathway. Copies of these memoranda are attached.

Following the meeting with the PRPs for the South Bay site on July 1, Mr. Manzanilla met with the Region 9 toxicologists, remedial project managers and others to discuss the technical issues raised in that meeting. One of the outcomes of that internal EPA meeting was the transmittal of the June 30, 2014 memorandum from the Region 9 toxicologists to the Superfund Division without any revisions following the July 1st meeting with the PRPs.

The attached memoranda apply to all NPL sites in Region 9. However, because EPA has previously issued a letter that in part covered these issues regarding the South Bay NPL sites, I am writing to clarify the relationship of the attached memoranda to EPA's December 3, 2013 letter. These memoranda supersede Item #1 (Interim TCE Indoor Air Short-term Response Action Levels and Guidelines) in our letter to you of December 3, 2013. We look forward to discussing these memoranda with you and your staff.

We appreciate all of the continuing work by you and your staff on these important Superfund sites and we value the partnership with the RWQCB on these matters.

Sincerely,

John Lyons
Acting Assistant Director,
Superfund Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

MEMORANDUM

July 9, 2014

Subject: **EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion**

From: **Enrique Manzanilla**
Director
Superfund Division

To: **Region 9 Superfund Division Staff and Management**

At my request, Gerry Hiatt and Dan Stralka have prepared the attached memorandum with their technical assessment and recommendations regarding action levels, investigation approaches and response measures to address "inhalation exposures to trichloroethylene (TCE) in indoor air from the subsurface vapor intrusion pathway." The memorandum contains a useful operational framework and point of departure for Region 9 Superfund staff and management, in particular for Remedial Project Managers (RPMs) and On-Scene Coordinators (OSCs). I am asking each of you to consider this technical assessment and the resulting recommendations in making site-specific decisions regarding the investigation of and response to TCE vapor intrusion.

Addressing vapor intrusion at our Superfund sites is one of the top priorities for the Superfund Division. When a completed vapor intrusion pathway exists, current exposure can potentially result in risks to human health (both long term cancer risks and near term non-cancer hazards). The recommendations set forth in the attached memorandum address a particular concern for TCE focusing on protecting sensitive and vulnerable populations. especially women in the first trimester of pregnancy (because of the potential for cardiac malformations to the developing fetus). We have been in regular communication with OSWER regarding these issues and our toxicologists consulted with their peers in OSWER in developing their memorandum.

Numerous resources are available within the Superfund Division to help RPM's and OSC's evaluate and manage the many issues that arise when investigating or responding to vapor intrusion at a site. Our Technical Support Section, including Dan and Gerry, is available to provide assistance and advice. And the Division has established the Vapor Intrusion Core Team that can be an important resource that is available to all of you. Over the coming months, the VI Core Team will be sharing their recommendations and insights regarding investigation approaches/techniques, mitigation approaches and innovative pilots/treatability work building on our experience within Region 9 (e.g., MEW, Omega, SEMOU, Amco, the South Bay sites etc.).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

MEMORANDUM

June 30, 2014

Subject: **EPA Region 9 Interim Action Levels and Response Recommendations to Address Potential Developmental Hazards Arising from Inhalation Exposures to TCE in Indoor Air from Subsurface Vapor Intrusion**

From: **Gerald Hiatt, Ph.D.**
Senior Regional Toxicologist

Daniel Stralka, Ph.D.
Regional Toxicologist

Through: **John Kennedy**
Chief, Technical Support Section

Angeles Herrera
Chief, Federal Facilities & Site Cleanup Branch

To: **Enrique Manzanilla**
Director, Superfund Division

We recommend that the EPA Region 9 Superfund program establish health protective response action recommendations to address inhalation exposures to trichloroethylene (TCE) in indoor air from the subsurface vapor intrusion pathway. The purpose of these interim action levels and response action recommendations is to be protective of sensitive and vulnerable populations, especially women in the first trimester of pregnancy, because of the potential for cardiac malformations to the developing fetus. This approach is consistent with recommendations provided by Region 10[1] and with previous actions taken at Region 9 Superfund sites.

Issue:

EPA identifies an inhalation level of concern for non-cancer hazards based on the ratio of the exposure concentration in air to a reference concentration ("RfC", which includes a margin of safety such that at the RfC and below there is little chance of an adverse effect).[2] This ratio is

[1] Memo: "OEA Recommendations Regarding Trichloroethylene Toxicity in Human Health Risk Assessments." JC Kelly, Office of Environmental Assessment, U.S. EPA Region 10, Dec 13 2012.

[2] The RfC represents an estimate of the continuous inhalation exposure (with uncertainty spanning perhaps an order of magnitude) to the human population (including sensitive sub-groups) that is likely to be without appreciable risk of deleterious effects during a lifetime. See on-line glossary at: http://www.epa.gov/ncea/iris/index.html

defined as a Hazard Quotient and abbreviated "HQ". EPA's Integrated Risk Information System (IRIS) 2011 toxicity assessment concluded that TCE exposure poses potential human health hazards for noncancer toxicity to multiple organs and systems and to the developing fetus, including fetal cardiac malformations. This and other findings in the IRIS assessment of TCE indicates that women in the first trimester of pregnancy are one of the most sensitive populations to TCE inhalation exposure. For fetal cardiac malformations, a specific developmental effect, the critical period for exposure is considered to be the approximate 3-week period in the first trimester of pregnancy during which the heart develops. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and Superfund guidance provide for early or interim actions where warranted by the hazards posed by site-related contamination.[3]

EPA Region 9 Interim TCE Indoor Air Response Action Levels - Residential and Commercial TCE Inhalation Exposure from Vapor Intrusion		
Exposure Scenario	***Accelerated Response Action Level (HQ=1)***	***Urgent Response Action Level (HQ=3)***[4]
Residential *	**2 µg/m³**	**6 µg/m³**
Commercial/Industrial ** (8-hour workday)	**8 µg/m³**	**24 µg/m³**
Commercial/Industrial ** (10-hour workday)	**7 µg/m³**	**21 µg/m³**

* The residential HQ=1 accelerated response action level is equivalent to the inhalation reference concentration (RfC) since exposure is assumed to occur continuously.

** Commercial/Industrial accelerated response action levels are calculated as a time-weighted average from the RfC, based on the length of a workday and rounding to one significant digit (e.g., for an 8-hour workday: Accelerated Response Action Level = (168 hours per week/40 hours per week) x 2 µg/m³ = 8 µg/m³). Time-weighted adjustments can be made as needed for workplaces with longer work schedules.

Note: Indoor air TCE exposures corresponding to these accelerated response action levels would pose cancer risks near the lower end of the Superfund target cancer risk range, considering the IRIS toxicity assessment; thus, the health protective risk range for both accelerated response actions and long-term exposures becomes truncated to: 0.5 – 2 µg/m³ for residential exposures and 3 –8 µg/m³ for 8-hour/day commercial/industrial exposures.

[3] The NCP preamble states (55 *FR* 8704): "EPA expects to take early action at sites where appropriate...to eliminate, reduce, or control the hazards posed by a site...In deciding whether to initiate early actions, EPA must balance the desire to definitively characterize site risks and analyze alternative remedial approaches for addressing those threats in great detail with the desire to implement protective measures quickly. Consistent with today's management principles, EPA intends to perform this balancing with a bias for initiating response actions necessary or appropriate to eliminate, reduce, or control hazards posed by a site as early as possible." Consistent with CERCLA and the NCP, early actions may be appropriate using CERCLA authority to carry out removal actions (emergency response, time critical response, or non-time critical response) or remedial actions based on the site-specific situation (see, for example, 40 CFR 300.415 (b)(1)-(3) and 300.430 (a)(1)(ii)(A)). See also U.S. EPA (2/14/2000), Use of Non-Time Critical Removal Authority in Superfund Response Actions (OSWER, OERR; OECA, OSRE).

[4] There is a need to identify those TCE exposures that exceed the RfC by a magnitude sufficient enough that a more urgent response is prudent; it is generally Region 9 practice to immediately initiate response action to address exposures at or above an HQ=3 level.

Based upon the above information from EPA's 2011 *Toxicological Review of Trichloroethylene in Support of the Integrated Risk Information System (IRIS)*, we recommend Region 9 establish interim action levels and response action recommendations to protect against potential non-cancer outcomes, including developmental effects such as cardiac malformations. These recommendations identify women of reproductive age as the sensitive population of concern, rather than only pregnant women, because some women may not be aware of their pregnancy during the critical period of the first trimester.

Recommendations for Assessment of TCE Inhalation Vapor Intrusion Exposure in Residential and Commercial/Industrial Buildings and Accelerated and Urgent Response Actions

The following recommendations should be used for assessing and responding to inhalation exposures to TCE in residential and non-residential/commercial/industrial settings caused by subsurface vapor intrusion at Region 9 Superfund sites. We also recommend consultation with an EPA Regional Toxicologist for implementation of these recommendations.

Sampling Considerations:
Generally, EPA recommends time-integrated air sampling methods to account for temporal variability in vapor intrusion. Time-integrated samples provide a direct measurement of the average TCE concentration over a fixed period of time (e.g., 8 hours, 24 hours, 4 days, 1 week, 2 weeks, etc.), which should be compared to the accelerated and urgent response action levels.

Considerations for When to Expedite Turn-around Time for TCE Analytical Results:
In determining the advisability of contracting for rapid (e.g., 24-72 hour) turn-around time for TCE analytical results for indoor air samples, the following factors should be taken into consideration:

- **Exposure of women of reproductive age** – Are women of reproductive age (or known pregnancy status) exposed or reasonably expected to be exposed?
- **Existing data** – Are there any existing data (e.g., from subsurface media) which indicate or suggest that indoor air TCE concentrations can exceed the accelerated response action level?
- **Multiple lines of evidence** – Are there other types of existing information, data or analytical results which indicate or suggest that indoor air TCE concentrations exceed or can exceed the accelerated response action level?
- **Confirmation sampling** - If previous TCE indoor air concentrations exceeded the accelerated response action level, and early or interim mitigation measures were taken, rapid turn-around time of TCE analytical results should be considered to verify TCE concentrations have been reduced sufficiently to below HQ=1.

Implementation of Early or Interim Measures to Mitigate TCE Inhalation Exposure:
When selecting a response to reduce or avoid inhalation exposures to TCE, we recommend the following early or interim response actions (mitigation measures) be considered, along with how quickly they can be implemented:

- Increasing building pressurization and/or ventilation
- Sealing potential conduits where vapors may be entering the building
- Treating indoor air (carbon filtration, air purifiers)

- Installing and operating engineered exposure controls (sub-slab/crawlspace, depressurization systems)
- Temporarily relocating occupants

Tiered Response Actions:

- **TCE Indoor Air Concentration ≤ Accelerated Response Action Level (HQ=1):** If indoor air TCE concentrations are observed to be equal to or less than the accelerated response action level, then we recommend routine periodic confirmatory sampling and/or monitoring be conducted as appropriate for conditions at the site, including evaluation of the potential for subsurface vapor intrusion into indoor air exceeding health-based screening levels for long-term exposure.
- **TCE Indoor Air Concentration > Accelerated Response Action Level (HQ=1):** In the event indoor air TCE concentrations are observed to be greater than the accelerated response action level, we recommend early or interim mitigation measures be evaluated and implemented quickly, and their effectiveness (defined as a reduction of the TCE indoor air concentration to below HQ=1 level) confirmed promptly (e.g., all actions completed and confirmed within a few weeks).
- **TCE Indoor Air Concentration > the Urgent Response Action Level (HQ=3):** In the event indoor air TCE concentrations are observed to be greater than the urgent response action level, we recommend mitigation measures be initiated immediately and their effectiveness (defined as a reduction of the indoor air TCE concentration to below HQ=1 level) confirmed before any additional exposure is allowed to occur (e.g., all actions completed and confirmed within a few days). Note that temporary relocation may be indicated under these circumstances because of the need to prevent additional exposure.

Basis for Tiered Response Actions:

The *Toxicological Review of Trichloroethylene in Support of the Integrated Risk Information System (IRIS)* (EPA 2011a) established an inhalation Reference Concentration (RfC) at 2 $\mu g/m^3$ to be protective for sensitive populations, including the developing fetus with regard to the potential for congenital heart defects arising due to maternal TCE exposure during fetal development. Identification of this developmental effect as a critical toxic end-point and the method of calculation of the RfC were the subjects of peer review by the EPA Science Advisory Board, which supported both.

This RfC in the 2011 TCE IRIS Assessment applies to continuous (24 hours per day) exposures and is therefore directly relevant to a reasonable maximum exposure in a residential exposure scenario. We recommend health protective inhalation concentrations for less-than-continuous exposures, such as in a commercial/industrial setting, be adjusted based on the number of hours per day of exposure.

Application of the RfC in the present context allows calculation of Hazard Quotient (HQ) concentrations for exposures equivalent to the RfC (HQ=1) and exceeding the RfC by a factor of 3-fold (HQ=3). Note: It is appropriate for the resultant HQ to be adjusted to a time-weighted average for exposures that are less than continuous. Thus:

- **Indoor Air Exposure Concentrations ≤ HQ=1:** Indoor air exposures equal to or below (less than) the relevant HQ=1 level are protective for inhalation exposure.

- **Indoor Air Exposure Concentrations > HQ=1**: For some exposure above the HQ=1 level, the non-cancer hazard begins to increase. This hazard generally increases as the exposure (considering concentration, time, and frequency) exceeds the HQ=1 level. Because of the increased potential risk of a developmental effect, we recommend reducing exposure to below HQ=1 using an accelerated time-frame.
- **Indoor Air Exposure Concentrations HQ=3**: The HQ=3 level is the level of exposure at which the increased risk of developmental effects is high enough that Region 9 considers an urgent response is warranted to reduce exposure for sensitive population to below HQ=1.

References:

Agency of Toxic Substances Disease Registry (ATSDR). 2013. Addendum to the Toxicological Profile for Trichloroethylene. Currently available online at:
http://www.atsdr.cdc.gov/ToxProfiles/tce_addendum.pdf

U.S. Environmental Protection Agency (EPA). 2011a. Toxicological Review of Trichloroethylene in Support of the Integrated Risk Information System (IRIS). EPA/635/R-09/011F. National Center for Environmental Assessment. Washington, DC. Currently available online at:
http://www.epa.gov/iris/toxreviews/0199tr/0199tr.pdf

U.S. Environmental Protection Agency (EPA). 2011b. IRIS Toxicity Profile for Trichloroethylene (CASRN 79-01-6). Washington DC, USEPA. http://www.epa.gov/iris/subst/0199.htm

U.S. Environmental Protection Agency, Science Advisory Board (EPA-SAB). 2011. *Review of EPA's Draft Assessment entitled —Toxicological Review of Trichloroethylene// (October 2009).* EPA-SAB-11-002. Office of the Administrator. Washington, DC. January 11.
http://yosemite.epa.gov/sab/sabproduct.nsf/B73D5D39A8F184BD85257817004A1988/$File/EPA-SAB-11-002-unsigned.pdf

Abbreviations:

HQ	Hazard Quotient (HQ = Exposure Concentration / RfC)
IRIS	Integrated Risk Information System
RfC	Reference concentration (inhalation)
TCE	Trichloroethylene
$\mu g/m^3$	micrograms per cubic meter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

MEMORANDUM

DATE: December 19, 2013

SUBJECT: Vapor Intrusion Comments, AMD 901/902, Phillips, and TRW Microwave Offsite Operable Unit, Sunnyvale, California

FROM: Melanie Morash, Remedial Project Manager
US EPA Region 9

TO: Max Shahbazian, Professional Geologist
San Francisco Bay Regional Water Quality Control Board

Thank you for the opportunity to participate in the indoor air investigations for the subject site and to provide these comments for development of Indoor Air Testing Work Plans, in addition to those South Bay Site vapor intrusion guidelines conveyed by my office to yours by letter dated December 3, 2013. Please do not hesitate to contact me if there are any questions, or if I can be of further assistance (morash.melanie@epa.gov / 415-972-3050).

General Comments:

(1) Vapor Intrusion Evaluation Study Area

In the Offsite Operable Unit (OOU) – the mixed residential, commercial, and industrial neighborhood located down-gradient from the AMD 901/902, Phillips, and TRW source sites – a comprehensive off-property vapor intrusion evaluation in the area over which shallow groundwater concentrations exceed 5 micrograms per liter (µg/L) of TCE will be required.

The evaluation should include, but not be limited to:

- additional vapor intrusion evaluations at the Rainbow Montessori Child Development Center Property (Montessori School), located at 790 East Duane Avenue in Sunnyvale
- additional vapor intrusion evaluations at the King's Academy School (King's Academy), located at 562 North Britton Avenue in Sunnyvale
- vapor intrusion evaluations at the CCLC Preschool, located at 794 East Duane Avenue in Sunnyvale

- all other schools, single-family residences, multi-unit apartment buildings, commercial and industrial properties, and any other buildings overlying the 5 µg/L TCE shallow groundwater contour line

- community outreach efforts, in conjunction with the Agencies, to affected residents, tenants and property owners

(2) Items to Include in Indoor Air Testing Work Plans

Background Information:

- Historical background section, including summary of vapor intrusion evaluation and mitigation work performed to date, and description of building use and occupancy;
- Building survey results on chemical use, operations, HVAC systems, and current and historical facility and property information;
- Building subsurface conditions and features, including potential preferential pathways for subsurface vapor intrusion; and
- Summary of relevant previous data collected at and near the building (e.g., groundwater, soil gas, sub-slab soil gas, crawlspace, pathway and outdoor air samples).

Project Team & Community Outreach:

- Project team organization, roles, responsibilities, and contact information; and
- Coordination with EPA Region 9 on community outreach to property owner and tenants, if different.

Data Gathering:

- Building layouts and the proposed indoor air sampling locations;
- Methods for evaluating current indoor air ventilation (e.g., HVAC) operations, and identifying potential pathways for vapor intrusion;
- Indoor air data quality objectives, including a proposed tiered screening level for analyzing data and identification of the appropriate response actions and timelines.
- Comparison of analytical results to current screening levels, including EPA Region 9 interim short-term TCE indoor air action levels;
- Sampling design and strategies for indoor air sampling, including laboratory and field methodologies and analytical methods to be utilized, and coordination with EPA Region 9 on collection of split/co-located samples.
- Methods to be used in determining whether the indoor air contaminant concentrations are attributable to subsurface/former source area contamination or other sources, such as consumer products or outdoor background air sources;
- Pre-sampling building walk-throughs with building HVAC system and Agency personnel to

identify and/or confirm indoor air, crawlspace/subsurface, sub-slab, and outdoor air sampling locations, including breathing zone and preferential pathway samples;

- Multiple rounds of sampling, including rounds of colder-weather sampling for passively ventilated buildings;
- Identification and collection of samples from source buildings;
- Testing of with HVAC systems both on and off. For HVAC-off sampling, sample collection a minimum of 36 hours following HVAC system shut-down, and proceeding while HVAC systems are off; and
- Notification to the Agencies of sampling results within 48 hours of receipt from the laboratory.

Remedy Selection & Access:

- Description of presumptive interim vapor intrusion mitigation measures that may be taken if sampling or other conditions indicate such measures are necessary. These measures will be consistent with future response actions to be taken and reporting process after those measures have been taken;
- Description of potential long-term, engineered subsurface vapor intrusion mitigation systems to be considered, including plans for long-term operation and monitoring; and
- Description of access requirements for the work to be performed, existing access conditions, and expected additional tasks necessary and scheduled to obtain access.

Project Management & Scheduling:

- Data Management and Reporting Section of the Work Plan, including: (1) discussion of how historical data and future data will be organized, managed, and reported; (2) description of graphical presentation of relevant data, including analytical sampling data, quality assurance/quality control data, and multiple lines of evidence information; (3) description of reporting format for reports and distribution list of electronic and hardcopy submittals to the Regional Water Board, US EPA Region 9, and the property owner/tenant; and (4) description of types of information that will be posted and regularly updated on a publicly available website such as GeoTracker; and
- Work schedule, including sampling activities and associated tasks.

Montessori School Vapor Intrusion Work Plan Comments:

(1) Screening Level Exceedances

It is EPA's understanding that Locus Technologies, the consultant for Philips, has conducted annual indoor air monitoring at the Montessori School since a 2004 soil gas investigation at the property, and pursuant to a Work Plan for Indoor Air Monitoring, dated August 2005 (revised December).

Changes in evaluation methods and indoor air action levels

While the most recent indoor air monitoring report for the Montessori School, dated June 1, 2013, states that existing groundwater conditions do not pose unacceptable health risks at the property and that chemicals in the groundwater are not causing a significant vapor intrusion concern, EPA believes that insufficient data has been collected to make this statement. In particular, changes in recent years in vapor intrusion evaluation methods and action levels have prompted a reconsideration of the vapor intrusion pathway and additional vapor intrusion-related sampling at properties on and down-gradient of source areas.

How EPA evaluates indoor air for long-term exposures

One way that EPA evaluates indoor air is by comparing the concentrations of any chemicals detected to levels determined by EPA to be protective of human health for long-term exposure. For example, for cancer causing chemicals, EPA considers levels to be protective if they fall within the range of a 1 to 100 in a million increased lifetime cancer risk. The level that falls into the most protective end of the risk range—1 in a million increased lifetime risk—is what is used as the screening level for any particular chemical. After identifying the health protective levels, EPA then compares measured values to the lowest, most health-protective, end of the range. Although levels of exposure anywhere within the range may be acceptable, EPA's goal for indoor air exposures to Superfund site-related chemicals is to keep exposures as low as reasonably possible within the protective risk range.

EPA's indoor air screening level for TCE was recently revised downwards – from 1.2 micrograms per cubic meter ($\mu g/m^3$) to 0.43 $\mu g/m^3$, corresponding to an increased lifetime risk of 1 in one million for exposures at or above 0.43 $\mu g/m^3$ for TCE. Indoor air monitoring results for TCE within the Montessori School's Building H (0.43 and 0.44 $\mu g/m^3$ from samples collected on April 14, 2013, and 0.91 and 0.89 $\mu g/m^3$ from samples collected on September 30, 2012) were at or above EPA's recently lowered cancer protective Regional Screening Level (RSL) for residential exposure (0.43 $\mu g/m^3$) and the 2013 Regional Water Board Environmental Screening Level (ESL) for residential exposures (0.59 $\mu g/m3$).

In light of these exceedances, additional vapor intrusion-related sampling and analysis at the Montessori School is appropriate, as well as the preparation and implementation of a comprehensive vapor intrusion mitigation plan, as necessary.

(2) Inadequacy of HVAC as vapor intrusion control measure without proper oversight & approved Operations, Monitoring and Maintenance (OMM) Plan

We cannot rely solely on the Montessori School's heating, ventilation, and air-conditioning (HVAC) systems to maintain acceptable indoor air quality without adequate oversight or a long-term Operations, Monitoring, and Maintenance (OMM) Plan that has been reviewed and approved by the Agencies and signed by the property owner/tenant . The June 2013 indoor air sampling event at the property included an inspection of the HVAC systems, and identified numerous deficiencies in the ventilation systems, including screens needing replacement or cleaning, economizers that do not open

or close properly, checklists indicating HVAC unit clocks, timers and/or switches improperly set, lack of suction at certain outdoor air intakes, and filters in poor condition, improperly installed, or having major air leaks. The report concluded, "Cumulatively, these issues may affect indoor air quality by allowing chemicals to accumulate within the buildings over time."

As discussed above, if HVAC is to be used as a component of a vapor intrusion remedy for the property, a comprehensive, long-term OMM Plan must be submitted to the Agencies for review and approval, that includes at a minimum, a description of staff fully trained to implement the plan, specific inspection and maintenance protocols, procedures for following up on corrective action items, and regular training and recordkeeping requirements.

(3) Preferential Pathway Sampling

Preferential pathway sampling should be conducted, pursuant to discussions between Locus Technologies and Agency representatives during the September 30, 2013 site visit, including, but not limited to, the following locations:

- Building S – bathrooms adjacent to the office, classroom with the raised tile floors
- Building G – janitorial closet, electrical outlets in structural beams
- Building L – raised classroom crawlspace, teacher's room electrical box, access door in floor by bathrooms/cafeteria
- Auditorium – computer room adjacent to stage
- Crawlspace vent between buildings L & V
- Building V – wooden box w/plumbing, electrical room, crawlspace sample in floor adjacent to electrical room/bathrooms

PID screening should be conducted around the base of all structural supports and at outlets/electrical junction boxes.

It should also be verified whether electrical wiring passes through the floor in any of the school buildings, potentially serving as a preferential pathway for subsurface vapors.

It was noted that the southwestern-most room in Building L had a stagnant odor to the air and is a good candidate for breathing zone sampling.

Potential Sampling Locations at King's Academy:

The following potential sampling locations were identified by Agency representatives during the September 30, 2013 site visit with Locus Technologies and Phillips representatives:

- Sewer line beneath building
- Buildings or portions thereof located below grade
- Gym
    - Good candidate for breathing zone sampling
    - Small, poorly ventilated room adjacent to room with sofas that is adjacent to football locker room
    - Computer room adjacent to weight room that has electrical panel
    - Pathway sampling in bathrooms (fans were observed to be off)

- Large Gym
    - PID readings in trap doors in floor for the volleyball goal posts and in gaps in wallboard beneath water fountains
- Assembly Hall (priority for sampling - building observed to be under negative pressure)
    - PID survey of open electrical outlets
    - Pathway sampling in kitchen off assembly hall
    - PID readings around floor drains beneath refrigerator and ice machine
    - Pathway sampling off assembly hall

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

December 3, 2013

Stephen Hill, Chief
Toxics Cleanup Division
California Regional Water Quality Control Board – SF Bay Region
1515 Clay Street #1400
Oakland, CA 94612

SUBJECT: EPA Region 9 Guidelines and Supplemental Information Needed for Vapor Intrusion Evaluations at the South Bay National Priorities List (NPL) Sites

Dear Mr. Hill:

The United States Environmental Protection Agency (EPA) Region 9 appreciates the opportunity to work with the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) in conducting vapor intrusion evaluations at the following Regional Water Board-lead National Priorities List (NPL) or Superfund sites in the South San Francisco Bay Area (South Bay Sites) where trichloroethene (TCE) or tetrachloroethene (PCE) are contaminants of potential concern:

- AMD 901/902/TRW Microwave/Phillips and Offsite Operable Unit Combined Sites in Sunnyvale
- AMD 915 DeGuigne Drive Site in Sunnyvale
- Monolithic Memories Site (also known as AMD 1165/1175 Arques Avenue Site) in Sunnyvale
- Fairchild Semiconductor Site in South San Jose
- Hewlett Packard 620-640 Page Mill Road Site in Palo Alto
- Intersil/Siemens Site in Cupertino and Sunnyvale
- National Semiconductor Site (also known as Texas Instruments Site) in Sunnyvale
- Synertek Building 1 Site in Santa Clara
- Teledyne/Spectra-Physics Sites in Mountain View

EPA recognizes and appreciates all of the vapor intrusion work activities conducted to date at these sites. Pursuant to recent discussions with EPA Region 9, the Regional Water Board, and the potentially responsible party (PRP) representatives on planned upcoming vapor intrusion work activities, EPA

Region 9 is providing this letter to outline EPA's recommended TCE interim short-term indoor air response action levels and guidelines and clarify the use of California-modified indoor air screening levels that should be applied when assessing and responding to TCE and PCE subsurface vapor intrusion into indoor air.

In addition, this letter includes, as outlined in the Attachment, additional information and specific requirements for vapor intrusion evaluations for the South Bay Sites, consistent with the "multiple-lines-of-evidence" approach in EPA's 2013 Office of Solid Waste and Emergency Response (OSWER) *External Review Draft – Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air*. In reviewing the multiple lines of evidence that have been collected for the South Bay Sites, EPA Region 9 has identified data gaps that must be filled to fully evaluate the potential for vapor intrusion into buildings overlying the South Bay Sites' contamination.

EPA Region 9 recommends that the following guidelines and supplemental information be incorporated, as appropriate, into existing and future Vapor Intrusion Evaluation Work Plans (Work Plans) for each of the South Bay Sites:

- Interim TCE Indoor Air Short-term Response Action Levels and Guidelines
- PCE Indoor Air Screening Levels
- Residential Building Sampling Approach – Multiple Rounds of Sampling including Colder Weather and Crawlspace Sampling
- Commercial Building Sampling Approach – Building Ventilation System (HVAC)-Off, HVAC-On and Pathway Sampling
- On-Property Study Area Building Sampling
- Phased Approach and Clarification of Vapor Intrusion Off-Property Study Areas to Include Buildings Overlying 5 µg/L TCE Shallow-Zone Groundwater Contamination

EPA Region 9 will continue to provide technical vapor intrusion and community involvement and outreach support for the South Bay Sites.

If you have any technical questions, please contact Melanie Morash of my staff at (415) 972-3050 or by e-mail to morash.melanie@epa.gov.

Sincerely,

Kathleen Salyer
Assistant Director, Superfund Division
California Site Cleanup Branch

Attachment: EPA Region 9 Guidelines and Supplemental Information for VI Evaluations

Attachment: EPA Region 9 Guidelines and Supplemental Information Needed for Vapor Intrusion Evaluations at the South Bay National Priorities List (NPL) Sites

EPA Region 9 recommends that the following guidelines and supplemental information be incorporated, as appropriate, into existing and future Vapor Intrusion Evaluation Work Plans (Work Plans) for each of the South Bay NPL Sites, primarily with subsurface trichloroethene (TCE) and tetrachlorethene (PCE) contamination.

The additional information and specific requirements requested are consistent with the "multiple-lines-of-evidence" approach in EPA's 2013 Office of Solid Waste and Emergency Response (OSWER) *External Review Draft – Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air*.

In reviewing the multiple lines of evidence that have been collected for the South Bay Sites, EPA Region 9 has identified data gaps that must be filled in order to fully evaluate the potential for vapor intrusion into buildings overlying the subsurface contamination at each individual South Bay Site.

Item #1 – Interim TCE Indoor Air Short-term Response Action Levels and Guidelines

In September 2011, EPA published its *Toxicological Review of Trichloroethylene in Support of the Integrated Risk Information System (IRIS).* Recent findings on TCE conclude that women in the first trimester of pregnancy are one of the most sensitive populations to TCE short-term inhalation exposure due to the potential for heart malformation for the developing fetus.

EPA uses a level of concern for non-cancer effects as a ratio of the exposure concentration to a safe dose including an additional margin of safety, called a reference concentration (RfC). This ratio is defined as a Hazard Quotient and abbreviated "HQ". The IRIS assessment derived an inhalation RfC for continuous inhalation exposure to TCE, which is 2 micrograms per cubic meter (2 $\mu g/m^3$).

Because this is a developmental effect, the critical period for exposure is considered to be within an approximate 3-week period in the first trimester of pregnancy during which the heart develops. Scientific information on the exact critical period of exposure for this health impact is not currently available; however, general risk assessment guidelines for developmental effects indicate that exposures over a period as limited as 24 hours[1] may be of concern for some developmental toxicants.

In light of this RfC information, EPA Region 9 is using health protective response action levels and guidelines to address short-term inhalation exposures to TCE in indoor air from the subsurface vapor intrusion pathway. The purpose of these interim response action levels and guidelines is to be protective of one of the most sensitive and vulnerable populations, women in their first trimester of pregnancy, because of the potential for cardiac malformations to the developing fetus during this short timeframe.

These guidelines identify women of reproductive age as the sensitive population of concern, rather than only pregnant women, because some women may not be aware of their pregnancy during the first trimester.

[1] U.S. EPA. Guidelines for Developmental Toxicity Risk Assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/600/FR-91/001, 1991

Assessment of TCE Inhalation Vapor Intrusion Exposure and Prompt Response Actions in Residential and Commercial/Industrial Buildings: The interim TCE indoor air short-term response action levels should be included in Vapor Intrusion Evaluation Work Plans (Work Plans) for assessing and responding to inhalation exposures to TCE in residential and commercial buildings caused by subsurface vapor intrusion at the South Bay Sites.

Interim TCE Indoor Air Short-Term Response Action Levels Residential and Commercial TCE Inhalation Exposure from Subsurface Vapor Intrusion South Bay NPL Sites	
Exposure Scenario	***Prompt Response Action Level*** *(HQ=1)*[2]
Residential *	2 $\mu g/m^3$
Commercial/Industrial 8-hour workday	9 $\mu g/m^3$
10-hour workday (South Bay Sites) **	7 $\mu g/m^3$

* The Residential HQ=1 prompt response action level is equivalent to the inhalation reference concentration (RfC) since exposure is assumed to occur continuously over a 24-hour period.

** Commercial/Industrial prompt response action levels are calculated as the time-weighted average from the RfC - 9 $\mu g/m^3$ for an 8-hour workday; 7 $\mu g/m^3$ for a 10-hour workday. Based on input from commercial building owners and tenants, EPA Region 9 recommends use of the 10-hour workday for determining the appropriate response action levels for commercial/industrial buildings at the South Bay Sites. Time-weighted adjustments can be made as needed for workplaces with longer work schedules.

Note: These prompt response action levels are near the lower end of the Superfund Health Protective Cancer Risk Range;[3] thus, the Superfund Health Protective Risk Range for both long-term and short-term exposures is: 0.4 – 2 $\mu g/m^3$ for residential exposures and 3 – 9 $\mu g/m^3$ for 8-hour/day commercial/industrial exposures.[4]

TCE Indoor Air Concentration > Prompt Response Action Level (HQ=1): In the event the indoor air TCE concentration related to subsurface vapor intrusion is detected above the prompt response action levels (HQ=1), then interim mitigation measures should be evaluated and implemented quickly, and their effectiveness (defined as a reduction of the TCE indoor air concentration to below HQ=1 level) confirmed promptly (e.g., all actions completed and confirmed within a few weeks).

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[2] There is a need to identify TCE exposures that exceed the HQ=1 level by a magnitude sufficient enough that a more urgent response is prudent; it is EPA Region 9 practice to take immediate action to address exposures at or above an HQ=3 level.

[3] For cancer causing chemicals, the Superfund Health Protective Risk Range encompasses the range of concentrations EPA considers to be protective, from 1 to 100 in a million increased lifetime cancer risk. The level that falls into the most protective end of the risk range – 1 in a million increased lifetime risk – is what is used as the screening level for any particular chemical. After identifying the health protective levels, EPA then compares measured values to the lowest, most health-protective, end of the range. Although levels of exposure anywhere within the range may be acceptable, EPA's goal for indoor air exposures to Superfund site-related chemicals is to keep exposures as low as reasonably possible within the Superfund Health Protective Risk Range.

[4] U.S. EPA Region 9 May 2013 Regional Screening Levels: http://www.epa.gov/region9/superfund/prg/ Accessed November 2013.

Implementation of Interim Measures to Mitigate TCE Short-term Exposure: The following interim response actions (mitigation measures) should be considered along with how quickly they can be implemented to reduce exposure to below the TCE short-term response action levels:

- Increasing building pressurization and/or ventilation mechanically with fans or the building ventilation system by increasing outdoor air intake
- Installing and operating engineered, sub-floor exposure controls (sub-slab and/or crawlspace depressurization; or in some cases a soil vapor extraction system)
- Eliminating exposure by temporary relocation, which may be indicated when immediate response actions are warranted.

The following interim measures may also be considered, but may have limited effectiveness and require additional monitoring to verify their effectiveness:

- Sealing and/or ventilating potential conduits where vapors may be entering building
- Treating indoor air (carbon filtration, air purifiers)

Item #2 – PCE Indoor Air Screening Levels

EPA acknowledges that the California-modified indoor air screening levels for PCE differ from EPA's May 2013 Regional Screening Levels (RSLs) for PCE. EPA Region 9 would like to clarify that the California EPA Office of Health Hazard Assessment's PCE toxicity value should be used for all NPL sites within California, which includes the South Bay Sites.

Work Plans and reports should be prepared or revised, as appropriate, to evaluate indoor air sampling results using the California-modified indoor air screening level of 0.4 $\mu g/m^3$ for residential exposures and 2 $\mu g/m^3$ for commercial/industrial exposures. The Superfund Health Protective Risk Range for PCE is bounded by the 10^{-6} excess cancer risk (low end) and by the non-cancer HQ=1 (high end). Specifically, the Superfund Health Protective Risk Range for PCE is 0.4 – 40 $\mu g/m^3$ for residential exposures and 2-180 $\mu g/m^3$ for commercial/ industrial exposures.

Item #3 – Residential Building Sampling Approach – Multiple Rounds of Sampling including Colder Weather and Crawlspace Sampling

Recognizing the temporal and spatial variability of indoor air and subsurface concentrations, EPA generally recommends collecting more than one round of sampling and from multiple locations. In reviewing the multiple lines of evidence that have been collected for the South Bay Sites, EPA Region 9 has identified several data gaps that must be filled in order to complete the vapor intrusion evaluations at each site. Specifically, it appears that multiple rounds of indoor air sampling have not been collected. For some sites, sampling has not been conducted during colder weather months, nor have samples been collected from crawlspaces or basements, where such are present in buildings.

Research studies[5][6][7][8] have demonstrated that daily indoor air concentrations resulting from subsurface vapor intrusion can vary by two or more orders of magnitude in residential, passively ventilated structures. These studies also indicate that the highest indoor air concentrations usually occur when outdoor air temperatures are significantly lower than indoor air temperatures. Empirical indoor air data collected at passively ventilated buildings in the San Francisco Bay Area where multiple samples were collected indicate TCE indoor air concentrations from vapor intrusion up to two-to-three times higher during the colder months.

Work Plans should be revised to incorporate multiple rounds of sampling, including sampling during colder weather months (November through February, with January generally being the coldest month in the Bay Area), to assess the potential variability of indoor air contaminant concentrations during conditions when the potential for vapor intrusion may be higher. In addition, crawlspace, basement, and pathway sampling should be included, as appropriate, as part of the vapor intrusion investigation.

Finally, EPA Region 9 supports the use of longer-term passive samplers to help assess the temporal variability of indoor air vapor intrusion-related contaminant concentrations. The longer-term sampler provides a greater duration over which to average indoor air vapor intrusion levels for the purposes of completing the vapor intrusion evaluation, however EPA Region 9 is open to discussing sampling strategies for both the passive sampler and TO-15 canister.

Item #4 – Commercial Building Sampling Approach - Building Ventilation System (HVAC)-Off, HVAC-On and Pathway Sampling

Consistent with the multiple-lines-of-evidence approach recommended by EPA guidance, ongoing vapor intrusion evaluations at certain commercial buildings associated with some of the South Bay Sites have included soil gas, sub-slab soil gas, and/or potential preferential pathway sampling (such as near bathroom floor drains and from elevator shafts or mechanical rooms), as well as indoor air sampling during normal business hours with the building's heating, ventilation, and air conditioning (HVAC) systems operating.

In reviewing these lines of evidence, EPA Region 9 has identified as a data gap the lack of HVAC-off sampling for certain commercial buildings, and recommends that pathway sampling, where such sampling has not yet been conducted, be included in the multiple-lines-of-evidence evaluation.

Because EPA needs to evaluate the potential for subsurface vapor intrusion into buildings without reliance on the indoor air ventilation system and understand the full range of possible exposure scenarios, Work Plans must be prepared or revised, as appropriate, to include indoor air sampling with the building ventilation systems turned off in addition to sampling commercial buildings under current

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[5] Schumacher, B., R. Truesdale, and C. Lutes. Fluctuation of Indoor Radon and VOC Concentrations due to Seasonal Variations. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R/12/673, 2012

[6] Schumacher, B. and J. Zimmerman, U.S. EPA ORD, C. Lutes, ARCADIS, and R. Truesdale, RTI International. Indoor Air and Soil Gas Temporal Variability Effects on Sampling Strategies: Evidence from Controlled and Uncontrolled Conditions in an Indianapolis duplex. March 18, 2013 Association for Environmental Health and Sciences Foundation Conference: https://iavi.rti.org/WorkshopsAndConferences.cfm

[7] Johnson, P. Arizona State University. Multi-Year Monitoring of a House Over a Dilute CHC Plume: Implications for Pathway Assessment using Indoor Air Sampling and Forced Under-Pressurization Tests. March 18, 2013 Association for Environmental Health and Sciences Foundation Conference: https://iavi.rti.org/WorkshopsAndConferences.cfm

[8] Holton, C., H. Luo, Y. Guo, and P. Johnson, Arizona State University, K. Gorder and E. Dettenmaier, Hill Air Force Base. Long-term and Short-term Variation of Indoor Air Concentration at a Vapor Intrusion Study Site. March 22, 2012 Association for Environmental Health and Sciences Foundation Conference: https://iavi.rti.org/WorkshopsAndConferences.cfm

building operating conditions.

For HVAC-off sampling, sampling duration should begin a minimum of 36 hours following shut-down of the building ventilation systems (no outdoor air intakes into the building) and continue while HVAC systems remain off. Because there is a greater potential for elevated indoor air contaminant concentrations while the building ventilation is turned off, adequate notice must be provided to building management and potential occupants about the testing and the schedule for when the ventilation system will be shut off.

Item #5 – On-Property Study Area Building Sampling

At certain of the South Bay Sites, indoor air sampling was originally not required at specific On-Property Study Area (or former source area) commercial buildings that were thought to have a low potential for vapor intrusion (e.g., due to the presence of a vapor intrusion mitigation system such as a sub-floor vapor barrier or where living or workspaces are located above a ventilated underground parking garage).

However, vapor intrusion sampling has shown the potential for vapor intrusion to occur at buildings with existing vapor intrusion mitigation systems (for example, where the systems were damaged during building construction or renovation activities). For buildings overlying subterranean parking garages, preferential pathways such as elevator shafts and stairwells may also increase vapor intrusion potential into occupied living spaces.

EPA Region 9 would like to clarify that all On-Property Study Area buildings should be evaluated and sampled. For building space overlying subterranean parking, potential preferential pathways into the building indoor air space, such as elevator shafts and stairwells, should be evaluated.

Work Plans should be prepared or revised, as appropriate, to include pre-sampling walk-throughs to assess building and system conditions. These building surveys should identify if there are any conditions that may prompt any additional evaluation and sampling to assess the effectiveness of the vapor intrusion engineering controls of the buildings.

Item #6 – Phased Approach and Clarification of Vapor Intrusion Off-Property Study Areas to Include Buildings Overlying 5 µg/L TCE Shallow-Zone Groundwater Contamination

EPA supports the initial agreed upon prioritization of conducting vapor intrusion evaluations at commercial and residential buildings overlying higher TCE shallow A-zone groundwater contamination (greater than 50 µg/L for residential buildings and greater than 100 µg/L for commercial buildings). For those South Bay Sites where vapor intrusion evaluations have already begun, early project planning discussions culminated in a phased approach to delineating the Vapor Intrusion Off-Property Study Area, beginning with investigations in these higher concentration areas of the subsurface groundwater plumes.

The groundwater contamination at the South Bay Sites is generally very shallow, ranging between approximately 5 feet below ground surface (bgs) to 35 feet bgs. Ongoing data collection efforts at other similar vapor intrusion sites in Region 9, as well as nationally, have shown vapor intrusion potential into buildings overlying lower groundwater TCE concentrations (less than 50 µg/L for residential buildings and less than 100 parts µg/L for commercial buildings), at levels exceeding health protective indoor air levels. Factors include, but are not limited to, location relative to source areas,

impacts due to seasonal fluctuations in groundwater levels, preferential pathways into a building and other building-specific characteristics that facilitate upward migration of subsurface vapors into interior living and work spaces.

The use of the TCE 5 µg/L groundwater concentration as defining the extent of the Vapor Intrusion Evaluation Study Area is reasonable, supported by use of EPA's vapor intrusion screening level calculator, the generic default groundwater-to-indoor air attenuation factor of 0.001 and the appropriate Henry's Law conversion, empirical data, and mathematical modeling.

Work Plans shall be prepared or revised, as appropriate, to define the Vapor Intrusion Off-Property Study Area as the area bounded by the estimated TCE shallow zone groundwater contamination area greater than 5 µg/L. A comprehensive evaluation of the multiple lines of evidence collected for each site should be used in determining the potential for vapor intrusion at particular buildings and whether additional investigation and response actions are warranted. Any proposal to exclude particular buildings from indoor air sampling must be supported by a robust, site- and building-specific multiple-lines-of-evidence analysis.

Where contaminants other than TCE drive the vapor intrusion investigation, a site-specific and contaminant-specific analysis following the multiple-lines-of-evidence approach should be used to derive a sufficiently health protective study boundary for the vapor intrusion evaluation.

EPA supports a phased multiple-lines-of-evidence approach in prioritizing vapor intrusion investigations, for example: (1) colder weather indoor air sampling event and commercial building HVAC-off and HVAC-on sampling within the original Off-Property Study Area; (2) data evaluation and identification of data gaps, with subsequent additional multiple-lines-of-evidence data collection and analysis; (3) targeted step-out's to specific commercial/residential buildings or streets overlying lower contaminant concentration contour lines; and finally (4) full step-out and building-specific evaluation to off-property vapor intrusion study boundary line, or 5 µg/L for TCE.